International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2018 vol.18 N1.1, pages 489-496

Stages of sand reservoir formation in nizhne-karmalskoye super-viscous oil deposit

Korolev E., Sudakov V., Nikolaev D., Gabdelvalieva R., Usmanov S.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© SGEM2018. Nizhne-Karmalskoye super-viscous oil deposit is located within the western slope of the South Tatar arch of the Volga-Urals anteclise. In the structural plan, the deposit is a sedimentary accumulative uplift-bar of 13 km in length, 3-5 km in width and 35-50 m in height. The uplift-bar was formed at the end of the Ufa age. According to one of the hypotheses, the sand body has a delta-baric origin. The body is composed of well-sorted fine-grained graywacke sandstones, which are now reservoir rocks of the super-viscous oil deposit. The study of sand reservoirs has shown a complex geological history of their formation. At the stage of sedimentation, in conditions of active hydrodynamics of shallow water, sandstones with potentially high capacitive-filtration properties formed within the bar. Over time, the pore space was filled with authigenic calcite, in the structure of which impurity ions Mn2+ and paramagnetic centers SO3- were accumulated. The association of structural defects in the early diagenetic carbonate cement of sandstones indicates that the pore solutions of the bar structure were represented by desalinated sea water. The areas of the bar preserved in unchanged form show that before the arrival of the oil-water fluids, the calcite cement completely filled the pore space of the sandstones. The introduced water-carbonic solutions, preceding the water-oil fluids, dissolved calcite cement, creating a capacitive space for the arrival of hydrocarbons. Carbonic solutions, when interacting with effusive fragments, activated the hydrolysis processes. The product of hydrolytic reactions was analcite. Aggregates of analcime formed secondary cement in graywacke sandstones. The incoming hydrocarbons that filled the pores of the reservoir, inhibit all subsequent processes. The next stage of transformation of reservoir rocks is associated with the oxidation of hydrocarbons. Biochemical reactions of oxidation of hydrocarbons facilitated the saturation of pore solutions with carbon dioxide and hydrogen sulphide. As a result of this, rhombohedral crystals of dolomite and calcite began to form in the porous space of sand reservoirs. The relics of the early diagenetic calcite cement were metasomatically replaced by pyrite. Thus, there are three stages of the sand reservoirs formation in Nizhne-Karmalskoye super-viscous oil deposit. In the first, sedimentation-diagenetic stage, the primary structural framework of sandstones, cemented with calcite, was formed. In the second, fluid dynamic, the processes of carbonate cement dissolution and hydrolysis of fragments of effusive minerals became more active. In the third stage, biocost-metasomatic stage, dolomite, calcite and pyrite were formed in the sand collectors.

http://dx.doi.org/10.5593/sgem2018/1.1/S01.062

Keywords

Bar, Diagenesis, Diagenetic calcite cement, Sand reservoirs, Super-viscous oil deposit

References

[1] Khisamov R.S., Gatiyatullin N.S., Shargorodskiy I.E., Voytovich E.D. & Voytovich S.E. (2007). Geologiya i osvoenie zalezhey prirodnykh bitumov Respubliki Tatarstan (Geology and development of natural bitumen deposits of the Republic of Tatarstan), Kazan: FEN Publishing.

[2] Novikova S.P., Nurgaliev D.K., Sudakov V.A., Delev A.N., Nurgalieva N.G., Lyabipov M.R. & Akhmadullin R.R. (2017). The Main Features of the Geological Modeling Process of a Shallow Deposit of Super-Viscous Oil in Aspect of Development Strategy Planning with the Use of Steam-Assisted Gravity Drainage Method. Georesources 19(4), 331–340. https://doi.org/10.18599/grs.19.4.5.

[3] Mingazov M.N., Strizhenok A.A., Anoshina M.M., Saifutdinov M.A. & Satdarov R.R. (2017) Geodynamic aspects of heavy oil trap formation in Cheremshano-Bastrykskaya area, the Republic of Tatarstan. Neftyanoe Khozyaystvo-Oil Industry, 2017(6), 15–17.

[4] Khasanov D.I. & Grunis E.G. (2017). Modeling Peculiarities of Two Bitumen Deposits of the Sheshmian Horizon of the Ufimian Stage Located in the Republic of Tatarstan. Georesources, 19(1), 27-29. DOI: http://doi.org/10.18599/grs.19.L5.

[5] Khisamov R.S., Bazarevskaya V.G., Tarasova T.I., Kostina A.A., Abusalimova R.R. & Panina S.A. Classification of geologic cross-section types of Sheshminskian Pss sand sequence. Neftyanoe Khozyaystvo-Oil Industry, 2017(6), 27–29.

[6] Ellern S.S. & Shel'dyashova L.V. (1987) Tipy lovushek i zalezhey v ufimskikh otlozheniyakh Tatarii (The types of traps and deposits in Ufimian sedimets of Tatarstan), Collected papers “Geologiya i geokhimiya neftenosnykh otlozheniy” (Geology and geochemistry of oil bearing deposits), (pp. 81–94), Kazan: Publishing of KSU.

[7] Nurgalieva N.G., Ikhsanov N.A., Nurgaliev D.K. & Dautov A.N. (2016) Facial characteristics of the Ufimian bituminous sediments. Neftyanoe Khozyaystvo-Oil Industry, 2016(4), 62–70.

[8] Zakirov T.R., Galeev A.A., Korolev E.A., Nuriev I.S., Statsenko E.O. (2015) Estimation of sandstone reservoir properties using X-ray CT studies in Ashalchinskoye oil field. Neftyanoe Khozyaystvo-Oil Industry, 2015(8), 36–40.

[9] Mullakaev, A.I, Khasanov, R.R. & Galiullin, B.M. (2017) Mineralogy of sandstones and localization of oil matter in productive horizons of high-viscosity oil in permian deposits of the Volga-Ural region (Russia). SGEM2017 Conference Proceedings, 17(11), 353–358. DOI: 10.5593/sgem2017/11/S01.045

[10] Berner R.A. (1984) Sedimentary pyrite formation: An update. Geochimica et Cosmochimica Acta, 48(4), 605–615. https://doi.org/10.1016/0016-7037(84)90089-9.